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Teaching in a non-traditional classroom: experiences from a teacher-initiated design project

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ABSTRACT

This participatory design-based research study addresses the relational character of the physical learning environment and pedagogical practice in the context of a design project carried out at a Swedish upper secondary school. Three teachers initiated the project with the intent to introduce student centred pedagogy and increase active learning. In collaboration with the research team, they designed and furnished a classroom supportive for communication and intense interaction between students, and where students and teachers could work and construct knowledge together. Drawing on observations, video recordings and design conversations with the teachers, the analysis, which is inspired by Actor Network Theory, concentrates on the six month period when the teachers started to teach in the new classroom with focus on their experiences, asking what they experienced as advantageous and challenging. Considering the new learning environment as a network of socio-material relations consisting of a) physical and spatial agents, b) organisational structural agents, and c) teacher/teaching agents, we conclude that whereas some actors corresponded well and contributed to a well-coordinated classroom practice facilitating the project's intentions, some actors contradicted each other and challenged the same intentions.

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Introduction

An increased theoretical focus on (and empirical use of) constructivist student-centred pedagogy and perceptions of teaching as 'creating space for participation' (Helgevold, 2016) have brought about new ideas about what constitutes a classroom. The traditional classroom with student desks in rows and the teacher desk in the front is thought to foster passivity in students rather than actively engaging them, and is also believed to hinder student-centred pedagogies (e.g., OECD, 2013, 2017; Sigurðardóttir & Hjartarson, 2018). A common understanding is that certain environments correspond to certain types of pedagogical practices, and that a change from traditional teaching (in this context, the lecture format) to a student-centred pedagogical approach requires changes also in the physical environment (e.g., Daniels et al., 2017; Woolner et al., 2018). However, as has been demonstrated in studies worldwide, transforming teaching is challenging (e.g., Tam, 2015).

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For example, a literature review from the ILETC project (Innovative Learning Environments and Teacher Change) indicates that transforming teaching requires systematic professional learning on a long-term basis, and transformation of teaching methods as well as mindset (Bradbeer et al., 2019). Teachers respond to design programmes in various ways, by both negotiating and compromising with the (new) environments in which they teach (e.g., Alterator & Deed, 2013; Benade, 2017; Campbell et al., 2013; Deed & Lesko, 2015; French et al., 2020; Niemi, 2020; Saltmarsh et al., 2015). Furthermore, it is often not enough for individual teachers to make efforts to transform their teaching: rather, a reorganisation of all teaching at the school and within the wider school community is required (Cardellino & Woolner, 2019; Fletcher et al., 2017). A general conclusion from these studies is that the learning environment is crucial for successful teaching and learning (cf. Stadler-Altmann, 2016; Woolner, 2010) and for initiating processes of change (cf. Stadler-Altmann, 2018), and that, by themselves, non-traditional physical learning environments are not sufficient to catalyse pedagogical change. In other words, merely altering the layout of the classroom is not enough to also alter the teaching itself. The relationship between learning space design and pedagogical practice is a dynamic interplay (Byers et al., 2018; Carvalho & Yeoman, 2018; Woolner et al., 2014) between various interrelated and interacting factors such as 'ecology', 'organisation', 'staff culture' and 'student milieu' (Gislason, 2010) or, as framed by Bøjer (2019), an interplay between 'physical and spatial agents', 'organisational structural agents' and 'the practice of teachers'.

Teachers being exposed to *externally* initiated design programmes are common in the literature (e.g., Priestly, 2011; Sigurðardóttir & Hjartarson, 2016; Woolner et al., 2018), sometimes with conservative and traditional views about teaching and what a classroom should look like (Woolner et al., 2012), but the literature also reports on teachers as agents of change (Bernard et al., 2019; Lockton & Fargason, 2019; Van der Heijden et al., 2015), seldom as *initiators* of design projects, but still as active participants in projects collaborating with researchers and/or stakeholders outside the daily school practice (e.g., Bøjer, 2019; Woolner et al., 2012).

In order to investigate the (potential) role of teachers in transforming teaching practices, we observed and analysed a teacher-driven design project that aimed to transform traditional teaching into a more student centred pedagogy by designing and constructing a new classroom with inspiration from active learning classroom (ALC) principles (Baepler et al., 2016). The small teacher-driven design project in focus, aimed to transform traditional teaching into a more student centred pedagogy. In contrast to many other design projects, this initiative was taken by the teachers themselves, not through a top-down decision by politicians or others concerned primarily with school system management. These teachers also did not collaborate with politicians, school leaders or architects during the project, as so many other participatory design-projects have done (e.g., Bøjer, 2019; Sigurðardóttir & Hjartarson, 2016; Van Merriënboer et al., 2017; Woolner et al., 2012), although they did collaborate with a group of researchers. In dialogue with the research team, they designed and furnished a classroom to support a change from traditional teaching to student-centred pedagogy (which means, a classroom supportive to communication and intense interaction among students), where students and teachers could work and construct knowledge together. In this article, we focus on the teachers' reflections on their teaching in this new classroom with these two specific research questions

RQ1: What were the teachers' main experiences of starting to teach in the new classroom?

RQ2: What did they perceive as advantageous and challenging?

After presenting our findings, we discuss why some practices were experienced as advantageous and others as challenging, by looking at the new learning environment as a network of socio-material relationships. This discussion will target how pedagogical practice interacts with physical, spatial and organisational aspects of the learning environment, encouraging positive interactions but also creating tensions among elements.

Theoretical framework

Using a socio-material approach, we understand space and practice as interlocked parties in relationships that inform and influence each other (cf. Mulcahy et al., 2015). We discuss these relationships with inspiration from ANT (Actor Network Theory), well aware that there are many interpretations of ANT. In the broad context of ANT, socio-material relationships are conceptualised as *networks* in which *actors* (both human and non-human) engage (Latour, 1996). All actors, both 'someones' and 'somethings', are considered to have equivalent status in the networks no matter if they themselves act, or whether they represent somethings 'to which activity is granted by others' (Latour, 1996, p. 373). Within this idea of symmetry, they are all 'assumed to be capable of exerting force and joining together, changing and being changed by each other' (Fenwick & Edwards, 2010, p. 3). This idea of change, i.e. reciprocally affecting one another, is conceptualised as 'translation'. Human and non-human actors come together and connect, they work upon each other and affect each other to become part of a network of coordinated things—but sometimes they only partially connect, or fail to connect due to contradictions. Networks also connect to other networks and construct network assemblages. Analyses inspired by ANT can thus shed light on why certain connections work and others do not work, and why actors affect or translate each other in different directions. We found ANT relevant as an overall theoretical framework for illuminating how teachers' practices interact with other actors—specifically, how they affect each other in particular and context-bound ways. We see the teachers as actors in a network that itself is an actor producing pedagogies and cultures, but also producing resistance to pedagogies (e.g., resistance to routines, behaviours, materials, teachers, students, policies, curricula, reforms).

ANT does not supply any criteria for defining the scope of networking actors, so we therefore determined the scope with inspiration from the 'Learning environment triangle' (Bøjer, 2019, p. 77). Drawing on the learning environment triangle our analysis focuses on a) physical and spatial agents, such as the design of the room, furniture, material and technical equipment, etc.; b) organisational structural agents such as the subject-based and temporal organisation of teaching at the specific school; c) the practice of teachers, such as teacher instruction, methods, strategies, and routines. Furthermore, we understand that inter-relations among these actors can be more or less in harmony/conflict. As argued by Bøjer (2019), there is a need for a certain alignment between the various agents and their acts of 'activation' in order to create a balanced learning environment. In an ANT-inspired analysis of learning environments, the concepts correspondence and dissonance were used to address alignment/misalignment between

actors (Carvalho & Yeoman, 2018). We use the concepts of *correspondence* and *dissonance* to highlight the alignment/misalignment between the acts of activation by the actors mentioned above: *correspondence* refers to connection with no (or few) tensions, and *dissonance* refers contradictory relations and large tensions between them.

Methods

The study site was a small private upper secondary school in a large Swedish town. Many of the students attending the school had low study motivation and high absenteeism rates. In order to increase student engagement and motivation, the participating teachers wanted to abandon traditional instructional teaching in favour of student-centred pedagogies and constructivist active learning based on communication and interaction among students. They rejected the idea of the teacher being the source of all knowledge and wanted the students to be more in charge of their own learning. The teachers taught at the technical programme, the electrical programme and the aesthetic programme: one taught languages, one STEM subjects, and one computer programming. In order to achieve pedagogical change, the teachers contacted the local university for collaboration with researchers, and in 2017, cooperation with the research team began in the form of a three year design project (classroom design *and* teaching design).[1] The research group collected data and acted as pedagogical advisers participating in the teachers' team meetings throughout the project.

Most classrooms in the school were traditional classrooms with a whiteboard and a teacher desk in front and student benches arrayed in rows. In dialogue with the researchers, the teachers created a learning environment out of a school space that earlier had served as a student cafeteria and started to give lessons there. The new learning environment consisted of only two walls, and was furnished (inspired by Active Learning Classroom, ALC; Baepler et al., 2016) with round tables, each table being equipped with a whiteboard, and a projector to connect to a computer desktop, no front and back in the classroom and no teacher desk. The school administration and management supported the design project by enabling teachers to use teaching hours every second week in order to plan the new classroom, discuss methodology and methods, and evaluate the teaching once they had started to teach there.

The design project consisted of three phases: an *exploratory phase*, when the new classroom was designed and constructed and the methodology discussed, a *development phase*, when the teachers started to teach in the new classroom, and an *evaluation phase*, when the design project was evaluated by the teachers. The analysis presented in this article focuses on a selected sequence of six months of the development phase. Inspired by participatory design-based research, we observed and filmed[2] teaching in three school classes and conducted 'design conversations' (Holmberg, 2019), a kind of focus group conversation in which the teachers discussed their teaching and reflected on it together with the researchers. Each design conversation concentrated on teachers' and researchers' reflections on the lessons that had been performed, with inspiration and use of video-stimulated recall (cf. Consuegra et al., 2016). In addition, individual interviews with the teachers were conducted, two interviews with each teacher; these were aimed at getting more elaborated individual reflections and also at capturing their reflections from a retrospective perspective. The first round of interviews was conducted shortly after

Table 1. Description of data material and abbreviations in running text.

Source of data and abbreviations in running text	Characteristic of data	Recorded time
Design Conversations (DC): Teacher 1/2/3 DC 1/2/3/4/5	Reflections in collective communication context	6 hours
Individual interviews (Interview) Teacher 1/2/3 Interview1/2	Reflections in individual interview context	6 hours

the six month period of teaching, and the second round six months later. The semi-structured interview guide included open questions in which we asked for 'reflections', 'major incidents', 'challenges' and 'advantages', and also questions that more directly addressed observations from performed teaching. The analysis draws on audio recordings from five design conversations with video-recordings as secondary data, and six individual interviews (Table 1).

Data were coded and thematised in an iterative process as suggested by Creswell (2007). Data were coded and data relevant to each code were assembled, then codes were brought together into potential themes. The identified themes were found to be consistent over the five design conversations, over the two interview-rounds, and among the three individual teachers. Thus, when we report the findings, we concentrate on the most prominent themes, without taking notice of individual variations between teachers or variations over time. The study was conducted in accordance with national and international ethical guidelines (Swedish Research Council, 2017), and approved by the regional ethical board.[3] All participants provided appropriate informed consent in speech and writing before the project was started, and their consent to participate was renegotiated and updated several times during the course of the project.

Findings

Throughout the six-month period, the teachers taught in the new classroom and in the traditional classrooms in parallel. Lecturing, students working individually, or working in pairs were the main activities in the traditional classroom, whereas collaborative group work was the dominant activity in the new classroom. Examples of collaborative group work were literature seminars (in the subject Swedish), discussion and analysis of scientific articles (in STEM subjects), and web development assignments (in computer programming). In the following, we present four identified themes concerning the teachers' main experiences from teaching in the new classroom. The first two themes highlight the advantages perceived by the teachers, and the last two highlight the challenges.

Increased intensity in students' collaborative work

The teachers found that the intensity and focus in students' collaborative work increased in the new classroom. They attributed this increase to the round tables, the technical equipment and the overall spatial design of the classroom. The round tables were considered to enable student focus and intensity to a greater extent than did benches in rows, as all students were in obvious eyesight of their group members throughout the lesson. The tables created 'small bubbles' that screened off visual impressions from the

other student groups. Thus, the placement of students around these tables directed their attention towards their fellow group members, and minimised impressions from other students, activities or happenings in the classroom.

> *[. . .] the spatial design of the room makes a big difference. They only tend to see and observe the ones in their group, the group works more independently, they have their backs to the others and this is not always the case in the ordinary classroom. (Teacher 1, DC2)*

> *They are much more focused, they kind of start with what they are supposed to work with much faster. (Teacher 2, DC2)*

The spatial design of the classroom was further narrated as making demands on the students, e.g., through lacking spaces for escaping the teacher's attention:

> *[. . .] there is something in the environment that clearly signals that the students are expected to deliver or accomplish something there [. . .]. There is no back or corners where one can hide. [. . .] I have the same distance to all. In the traditional classroom, at least in my classroom, the students who are engaged sit far ahead close to me, and then they occupy quite a large part of my focus. They attract attention and those others sit further back and further out towards the edges and they kind of hide a little and they escape my attention. You cannot do that in here. (Teacher 3, Interview 1)*

The teachers also referred to the technical equipment as contributing to high intensity of the collaborative group work. At each table, the students collaborated using a computer desktop and a whiteboard, and their work in progress was visible on the board, not only to their fellows in the group, but also to the teacher and the rest of the students in the classroom. This was perceived as contributing to focused and intense work among the students:

> *When they* [the students] *all sit with a computer desktop each, it's more easy to float away, with one computer and one joint whiteboard there is much more focus in the group. (Teacher 1, Interview 1)*

> *The students are more active in group work, they are not disturbed by other students, they also make more accurate notes than they usually do, I guess because everyone in the room can see what they are writing. (Teacher 1, DC2)*

As demonstrated in this section, comments from the teachers about the students' collaborative work were not so much about *learning* through collaboration, but more about conduct and disciplinary issues. When reflecting on the communication in the new classroom (see next section), however, issues related to learning were raised.

Increased student-student communication and interaction

The teachers felt that they had a less central role in classroom communication than they did in the traditional classroom. For example, they believed that the students did not call for the teacher's attention as often as they did in the traditional classroom, and that they did not ask them as many questions as they normally did.

> *They sit together discussing and problematising the issue in focus, and they tend to ask me questions less often, instead they ask each other. (Teacher 2, DC2)*

One teacher expressed the feeling of having a less central role in the classroom by saying 'In this classroom I kind of disappear from the equation so to speak' (Teacher 2 DC1). In the new classroom, the students tended to ask questions to each other, which led to an exchange of ideas and reflections between the students, and students did this to an extent that teachers felt they did not observe in the traditional classroom. The teachers interpreted such an exchange of ideas and reflections as increased 'shared sense making' among the students—that is, that the students constructed their meanings in the social context that the new learning environment represented (cf. Vygotski, 1978). They felt that student discussions were based more on the students' own thoughts and experiences than on the teacher's talk and instructions.

> *In the ordinary classroom it is more like, I lecture and show how things work and then I introduce a working task and what happens then is that their work starts from my talk and my demonstrations, not from their own thoughts. (Teacher 3, DC2)*

The teachers discussed this new order in terms of a less hierarchical relationship between teacher and students (cf. Dovey & Fisher, 2014): 'Everyone is in some way equal in the classroom, both in relation to each other but also in relation to me [the teacher]' (Teacher 3, Interview 1). The new classroom space altered social relations, which facilitated increased communication and integration among students, which (reciprocally) benefitted the transformation from traditional teaching towards student centred pedagogy. This change towards more student-student communication was something the teachers welcomed because they wanted to invite students into meaning-making processes (cf. Helgevold, 2016). Actually, this shared meaning-making was expressed to be a main goal of the design project, and it was considered to be a thing that prepared students for working life:

> *I think this is very important partly for the students' development and learning and I also think about their future. As a teacher you cannot stand there and just lecture, telling them the 'truth'. They need to be active and work with problem solving and communication and things like that, because that is what they will do when they get a job. They need those kind of skills. (Teacher 1, Interview 1)*

The fact that discussions were concentrated around a few tables made the teachers experience that they more easily could follow the students' discussions and meaning-making in the new classroom:

> *I see them better and I hear them better. When they sit and talk together I kind of get a much better overview and I perceive their learning much better than I do in the traditional classroom. (Teacher 1, Interview1)*

A natural consequence of the physical layout was that teachers found it easier to move around in the classroom and get in direct contact with student groups and/or individual students, which was attributed to the absence of a teaching desk and whiteboard. However, it took a while for the teachers themselves to get accustomed to not having a base position in the classroom. In the first lessons they taught in the new classroom, they struggled with where to place themselves. No matter how they moved, they felt that they had students at their backs, but at the same time, standing pressed against one of the two walls felt unnatural. However, this feeling diminished as they got used to the design of the room.

The experience of better insight into student learning was also considered to be connected to the whiteboards. The whiteboards helped the students to visualise their work and meaning-making processes, which made it easier for the teachers to communicate with the students about their ongoing work. The boards facilitated comments and question asking, allowing the teachers insight into whether the students lacked or had achieved basic knowledge. The teacher who taught computer programming reflected that following a group's programming on the whiteboard gave him direct insight into the students' learning processes, and he could see what kind of input and support the students needed at the moment.

Difficulties in keeping the students on-track for longer periods of time

In contrast to the school's traditional classroom design, its time-schedule was rather non-traditional. While teaching in many Swedish schools is scheduled in 40–60 minutes lessons, all lessons in this particular school were 80 minutes long. This was a general challenge that all teachers had to deal with also when teaching in the traditional classroom:

> *I think this is a core problem, I actually don't think our students can handle the kind of time schedule we have. I think the students we have in our school need to focus in shorter sequences. (Teacher 1, DC2)*

In the new classroom, teachers experienced the school's time schedule as even more challenging than it was in the traditional classroom. The main reason was that the classroom was designed for group work only, which did not easily allow for combining various classroom activities, as is easier in flexible learning environments (Woodman, 2016). When teaching in the traditional classroom, teachers could more easily combine different kinds of classroom activities and thereby make the students stay on-track for 80 minutes (e.g., group work could go on while other students engaged in individual study with the teacher). This challenge has been noted also in other studies (e.g., Niemi, 2020, p. 8). Ready variation of teaching methods was described as helping the students focus on a task for long sessions. However, combining group work with lecturing did not work in the new classroom, because the students were placed in various directions around the tables, and there was no place for the teacher to easily be seen and heard by all. In addition, the teacher had neither desk nor whiteboard. For this reason, teachers often introduced the task for the group work and divided the students in groups in the ordinary classroom (that is, before moving to the new classroom), so that the collaborative group work could start immediately upon entering the new classroom.

In an attempt to help the students keep their focus and staying on-track for long hours the teachers elaborated the sequence and pace of the collaborative work. This more detailed structuring of the students' work was discussed regularly and thoroughly during design conversations with the researchers, and it was also reflected on in the interviews:

> *I started to think about the importance of starts and stops in terms of checks in order to facilitate guiding the students forward [. . .] In the beginning* [in the new classroom] *I had them work with the same task for long sequences, and well, I have shortened the sequences now, I think they need stops, so yes, I tend to think a little differently when planning lessons now. (Teacher 1, Interview 1)*

However, obtaining an ideal balance was experienced difficult, because too many 'stops' and 'starts' made the lessons too fractured, which tended to discourage students from keeping up their concentration. Furthermore, it was experienced as time consuming in terms of planning:

> *You need to think through and plan the lessons much more thoroughly than I am used to. This is a challenge, and can be tough as normally this is not how I prepare lessons. (Teacher 2, Interview 1)*

> *I need to think about the teaching material in a more structured and well thought out way and also think through the sequences and all parts more thoroughly. So the planning kind of takes more time. (Teacher 3, Interview 1)*

In order to keep the students on-track for 80 minutes, the teachers also experimented with how to compose student groups:

> *Putting together groups is crucial and not always easy. Because it is not only to put them* [the students] *together just like that. (Teacher 3, DC3)*

> *We have discussed this a lot, and well, in my last lesson, I randomised the groups, but as you know, there are clear divisions between groups in this class, and that kind of hampered the group work in the classroom, because there are some students that cannot stand each other. (Teacher 3, DC1)*

Antagonism between individual students and/or groups of students could hinder concentration. Deliberation about group composition also took into account the students' individual approaches to learning in terms of responsibility for their own and their fellows learning. Some students tended to, and sometimes strived to, escape individual responsibility in group work and took on a passive or contra-productive position, a behaviour that challenged the group to stay on-track. This phenomenon appeared also in the traditional classroom, however, with fewer negative effects than in the new classroom where the students activated each other to a greater extent. When individual students did not participate actively, they made it difficult for the group to complete the task and they subverted and undermined learning opportunities for the rest of the group (cf. Campbell et al., 2013, p. 216). The teachers addressed this problem by teaching the students cooperative strategies, for example, by having the students take on different roles within the group, e.g., the role of secretary, the role of chair, etc. (cf. taking on roles as 'reporter', 'checker', 'recorder' and 'researcher' in Johnson & Johnson, 1992).

Difficulties in catching up with the syllabus

A general reflection among the teachers was that the students worked actively and focused in the new classroom (even if it was hard for them to maintain concentration and keep on-track for 80 minutes), and in that sense they experienced teaching in the new classroom as 'effective' time.

> *I manage to achieve more structured lessons in the new classroom. It's a better environment for collaboration and communication. So I think we get more from it in less time, it gets more effective, both for me, what I want to achieve with the lesson, and for them as they become more focused. (Teacher, 1 Interview 1)*

However, in relation to the national course syllabus (which regulates the content, learning goals and length of a specific course), the teachers found teaching in the new classroom to be non-effective time, because they found it difficult to cover the content listed in the course syllabus in the stipulated time they had at their disposal. Intense group work and learning and making meaning by delving into discussions did not align well with the broad and extensive content in the course syllabuses and the number of teaching hours available, and when the teachers felt they were running out of teaching time for a specific course, they tended to skip group work activities in the new classroom, even though they understood them to benefit students' deep and active learning. The design of the classroom, the furniture, technical equipment and so forth acted in favour of students' learning, considering learning as meaning-making and knowledge construction (cf. Helgevold, 2016), but the syllabus counteracted these classroom practices, because the teachers experienced them as too time consuming relative to ordinary lecturing.

Discussion

As reported above, we identified four themes highlighting the teachers' main experiences (RQ1), namely two themes stressing what the teachers found to be advantageous and two themes stressing what they found challenging (RQ2). Looking at the new classroom space as a network of socio-material relations, we understand the identified *advantages*—increased intensity in students' collaborative work and increased student-student communication and interaction—as an effect of highly resonant relations between the teaching (practice) and the physical classroom space. These two 'actors' acted in correspondence to each other, they supported and 'translated' each other in strengthening ways, contributing to increased collaboration, communication, and interaction among the students. This, in turn, was perceived of by the teachers as active learning based on the students' own thoughts and activities more than teachers', and as an escape from the traditional teacher role, where the teacher is the (only) source of knowledge in the classroom (cf. Woodman, 2016). It is worth noting, though, that some of their talk about student collaboration, and particularly prominent in the first theme, concerned supervision of students' conduct more than active learning. Ideas about supervision and control of the students' work and conduct could also be sensed in some of their talk about transparency in the classroom, e.g., having the groups' ongoing work visible on the walls. The disciplinary regimes that applied to the teaching and learning cultures in ordinary classrooms, and to the overall organisational culture of the school, thus seemed to exist in this new learning environment as well, albeit in new forms.

We understand the *challenges*—difficulties in keeping the students on-track for longer periods of time and difficulties in catching up with the syllabus—as effects of dissonant relations between actors at classroom, school, and national level. When new and old actors came together in new constellations in the new classroom, they affected or 'translated' each other in new ways, and dissonances appeared between vertical relations—between teaching (practice) and the school's time-schedule, as well as between the teaching (practice) and national curricula and course syllabuses. Regulations at the national level counteracted the teachers' way of teaching for active learning. So did the school's organisation of teaching time, a finding that we relate to the fact that the design

project was not a *school* design project, but rather a classroom design project. The transformation of physical space and teaching practices took place in a delimited part of the school's overall pedagogical practice and organisational culture, and dissonances occurred in relation to organisational factors at school level and in relation to national regulations. This finding demonstrates that changes in the physical learning environment and teaching practice always take place in a specific temporal and spatial organisation of teaching at local school level (cf. Gislason, 2010), *and* within the framework of demands and structures at the macro-level (national curricula, assessment systems, etc.).

As argued previously, in order to achieve lasting pedagogical change, a school's organisational culture also needs to be involved, and a shared vision needs to be created (cf. Bøjer, 2019, p. 77; Niemi, 2020; Tam, 2015). This is thought to be particularly true of design projects that aim to convert the entire educational practice to team teaching in large-scale, flexible classrooms (see for example, Campbell et al., 2013; Yeoman, 2018), because these things are impossible to implement without restructuring a school's organisational culture. But, as this study has shown, this is also important when designing smaller projects that involve only part of the teacher collective at a school, simply because they are parts of larger organisational cultures. The overall organisational culture of a school refers to the management of the school, which encompasses leadership as well as time schedules and administration of the physical school structure, i.e. the routines of existing communities of practice (Bøjer, 2019, p. 78). Organisational cultures are in turn interconnected with and interact with, for example, the physical space and materialities of the learning environment, and the practices, ideas and values of teachers. Educational scholars with expertise in ANT discuss this in terms of 'actors' who interact and negotiate, and form networks of coordinated things and actions (Bøjer, 2019; Fenwick & Edwards, 2010). When local networks come together smoothly, they strengthen each other and create network assemblages which stabilise work and facilitate lasting pedagogical change. However, as been illustrated in this and other studies with the aid of ANT, local networks (at school and classroom levels) can be challenged by counter-actors and counter-networks at a macro level (in this study *national* curricula and course syllabuses), causing vertical dissonances and extorting adjustments and negotiations at local level, which complicates processes and makes pedagogical change unstable.

In this study, dissonant vertical relations provoked teachers to exercise professional knowledge and to try out new methods, coming up with strategies, adjusting, negotiating, etc. Most of their strategies helped develop teaching practice in the new classroom and adjust the contextual conditions and networks at other levels. However, some of their strategies were more of a kind of giving up: when the teachers felt they were running out of time and having difficulties getting through all the content stipulated in the syllabus, they abandoned the new classroom and kept to 'safe' lecturing in the traditional classroom. Whereas the theoretical framework underpinning the discussion attributes equal status to all actors in a network, our analysis illustrates teachers as core agents of pedagogic change at local level (cf. Bøjer's reflections on how she found the ANT analysis 'diminishing the role of the designer', p. 237). The teachers' practices caused corresponding but also dissonant relations with other network actors, and depending on how they negotiated and addressed these counteractions, their practices caused development of the design project to either advance or slow down. However, the teachers themselves did not talk much about their own roles as facilitators of pedagogic change. Even though they elaborated on strategies

during the whole six month period (cf. Campbell et al., 2013), they did not attribute as much agency to themselves as to the design of the classroom, its technical equipment, the school's time schedule and national course syllabuses and curricula, etc. They under-communicated what the historic didactic triangle pictures in terms of the instructional methods (the how) (Klette, 2007). As researchers, we employed ANT as a theoretical framework to look at the teachers' practice as only one of several actors interacting in the various and complex relationships that constitute a learning environment. Paradoxically, the same theoretical framework demonstrated that actors in a network enact agency to various degrees, and that the teachers we studied were important agents in the socio-material relationships at the classroom level, even though they did not articulate that themselves.

One conclusion we draw from this study is that it is important to consider many different factors (cf. Gislason's 'ecology', 'organisation', 'staff culture' and 'student milieu', and Bøjer's 'learning space design', school organisation' and 'pedagogical practices') when *planning* for pedagogical change, including factors above the local school or classroom 'level'. In the design project we studied, the teachers had carefully considered and taken into account the students' needs and level of motivation when designing the new classroom, but they had devoted less thought to, for example, the schools time schedule. The spatial design of the classroom aligned well with their new ideas about teaching and active learning, but they ended up with a discrepancy between the pedagogical practice and the schools' time schedule, and the new pedagogical practice made it difficult to meet the demands of the national curriculum and syllabuses. Perhaps it was precisely this that made them only see their own agency to a limited extent.

Notes

1. The project was funded by Umeå School of Education, Umeå University.
2. In video and audio documentation of teachers' lessons in ALC, a Canon XA11 video camera equipped with a wide angle lens was used, as were two microphones, one collecting audio from the teacher and the other collecting audio from the room, allowing data to be gathered from two sources.
3. Regional Ethical Board dnr 2017–402-31.

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